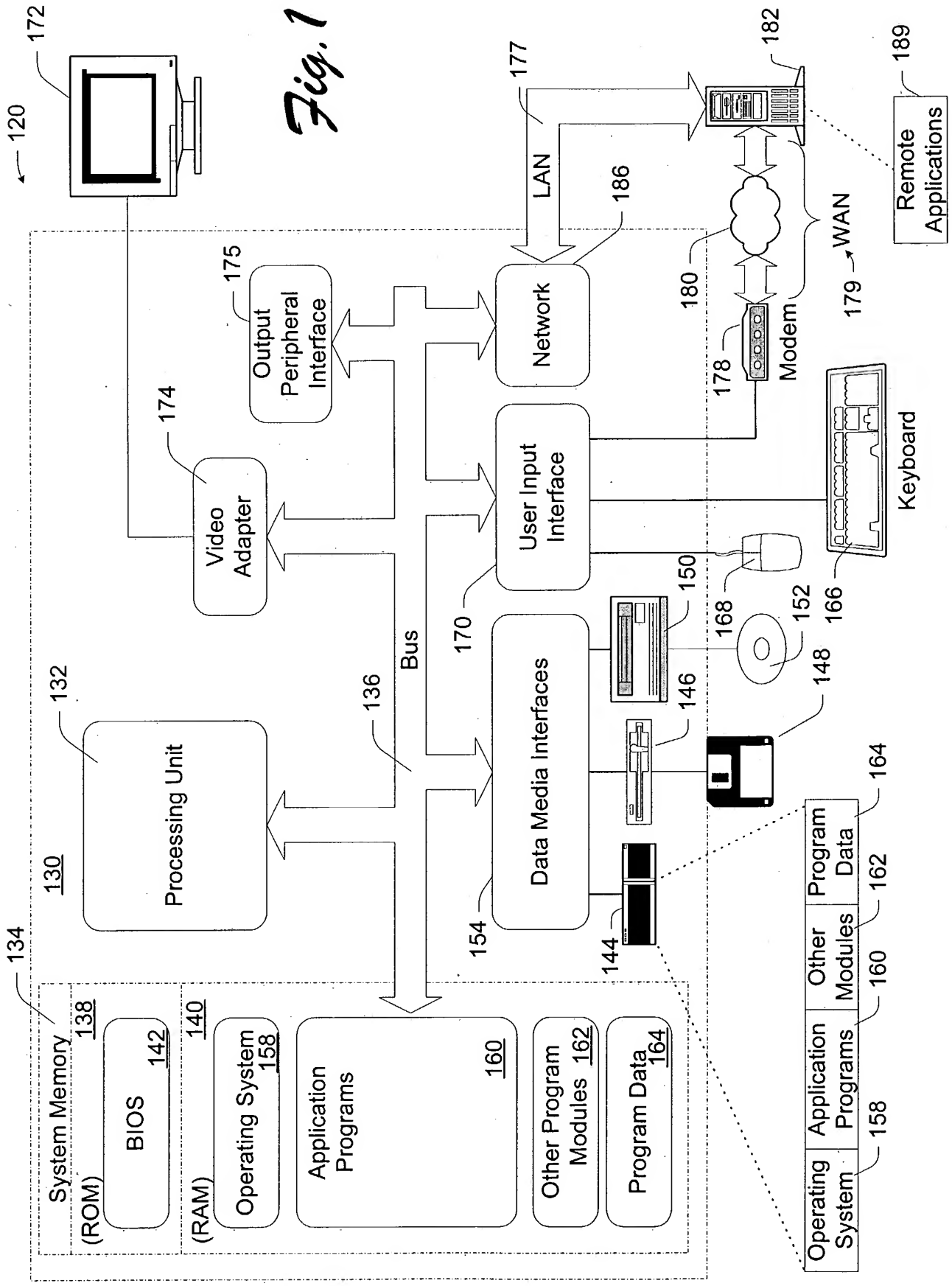

120
172
Fig. 1
177
182
189
LAN
WAN
Remote Applications
186
180
179
Network
Output Peripheral Interface
175
Modem
178
174
Video Adapter
User Input Interface
Keyboard
Bus
150
152
166
168
170
132
136
148
146
Processing Unit
Data Media Interfaces
130
154
144
164
162
160
158
134
System Memory
138
140
(ROM)
(RAM)
BIOS
142
Operating System
158
Application Programs
160
Other Program Modules
162
Program Data
164
Operating System
Application Programs
Other Modules
Program Data

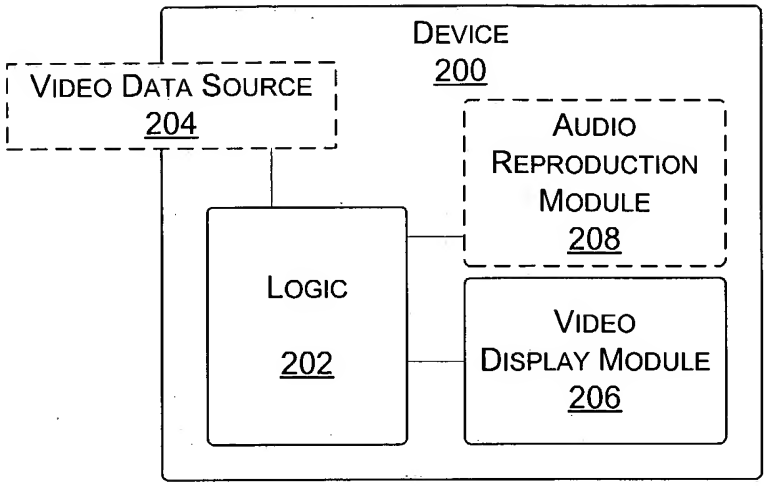

DEVICE
200
VIDEO DATA SOURCE
204
AUDIO
REPRODUCTION
MODULE
208
LOGIC
202
VIDEO
DISPLAY MODULE
206

Fig. 2

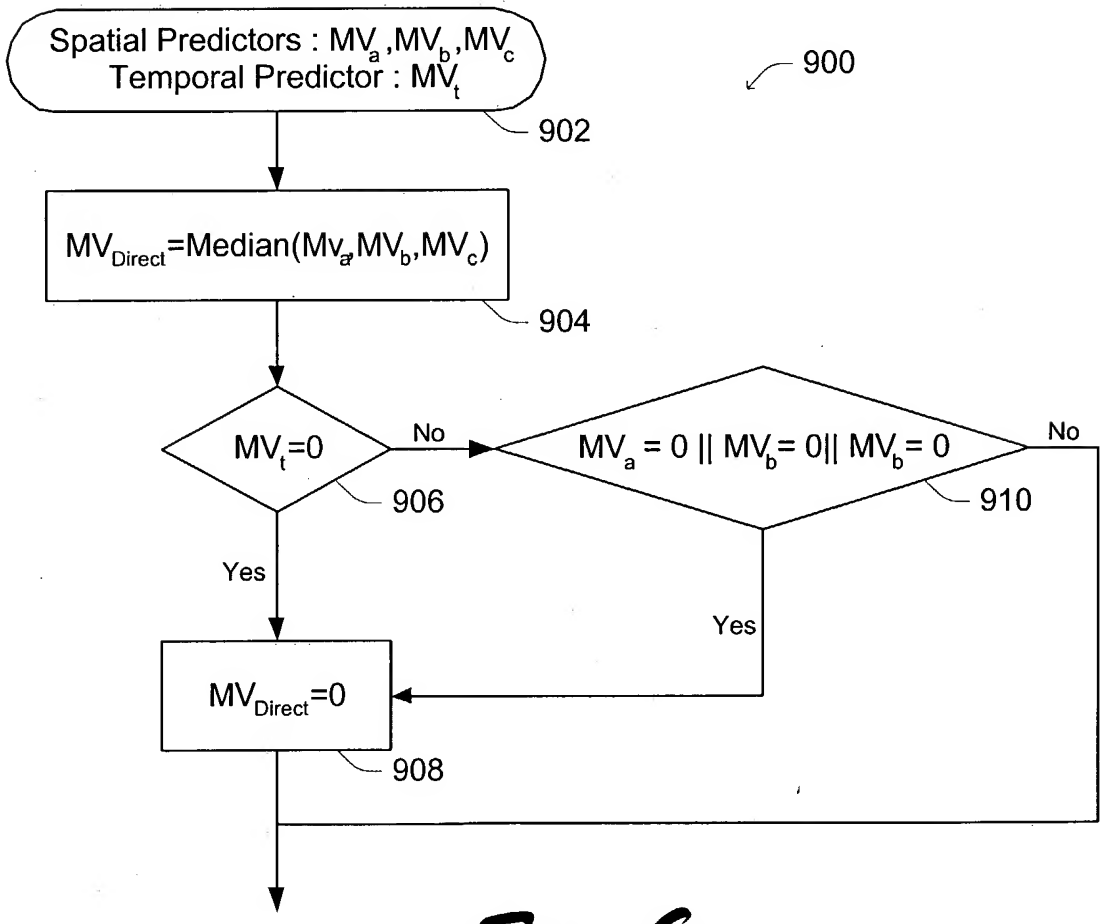

Spatial Predictors : MVa,MVb,MVc
Temporal Predictor : MVt
902
900
MVDirect=Median(MVa,MVb,MVc)
904
MVt=0
No
MVa = 0 || MVb= 0|| MVb= 0
No
906
910
Yes
Yes
MVDirect=0
908

Fig. 9

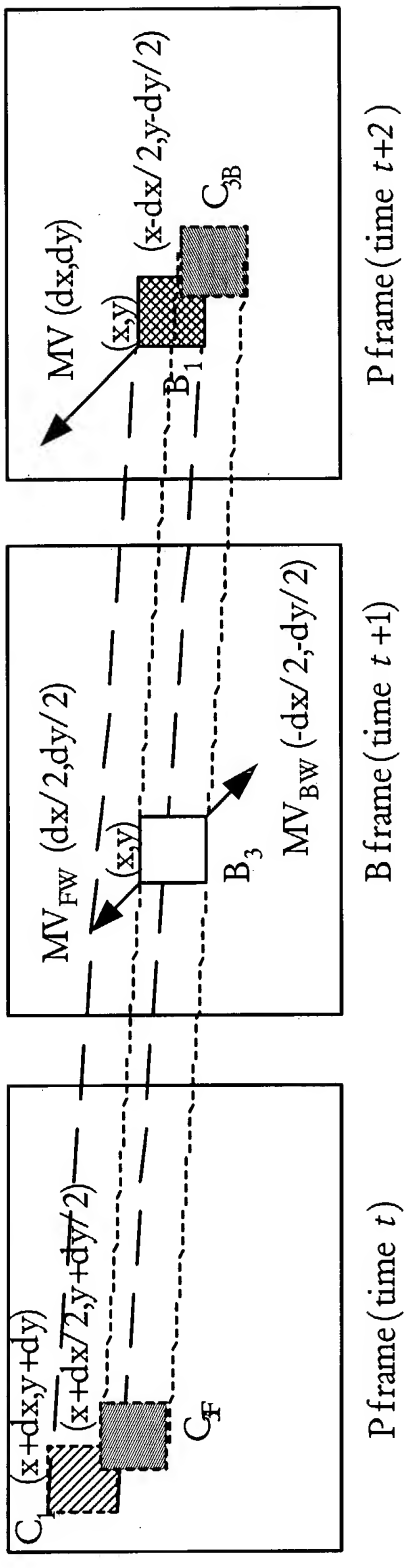

MV (dx,dy)
(x,y)
(x-dx/2,y-dy/2)
C_{3B}
B_1
P frame (time t+2)
MV_{FW} (dx/2,dy/2)
(x,y)
B_3
MV_{BW} (-dx/2,-dy/2)
B frame (time t+1)
C_t (x+dx,y+dy)
(x+dx/2,y+dy/2)
C_F
P frame (time t)

Fig. 3

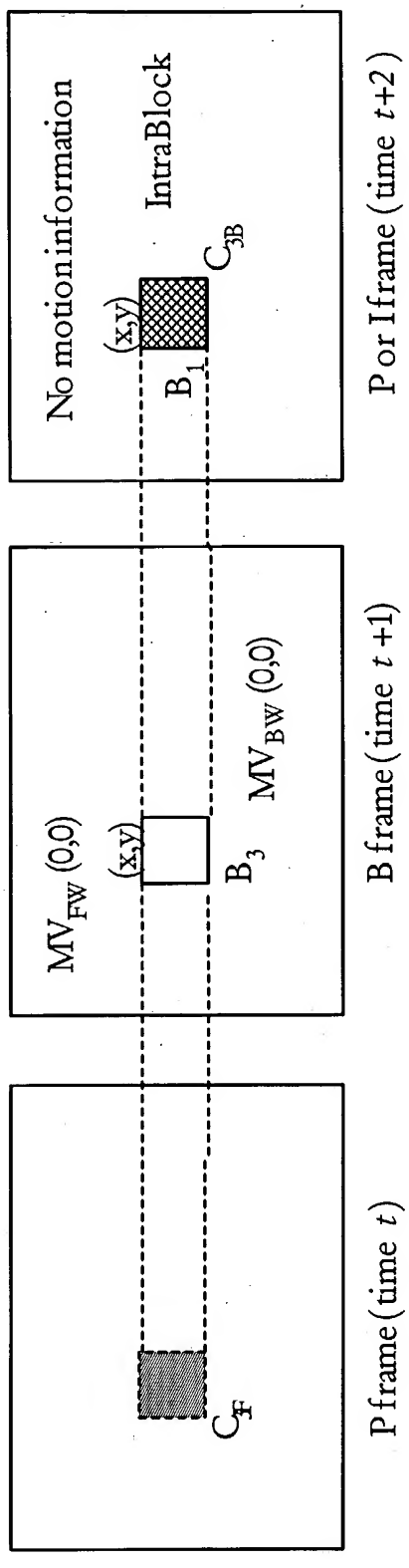

No motion information
IntraBlock
(x,y)
B_1
C_{3B}
P or I frame (time t+2)
MV_{FW} (0,0)
(x,y)
B_3
MV_{BW} (0,0)
B frame (time t+1)
C_F
P frame (time t)

Fig. 4

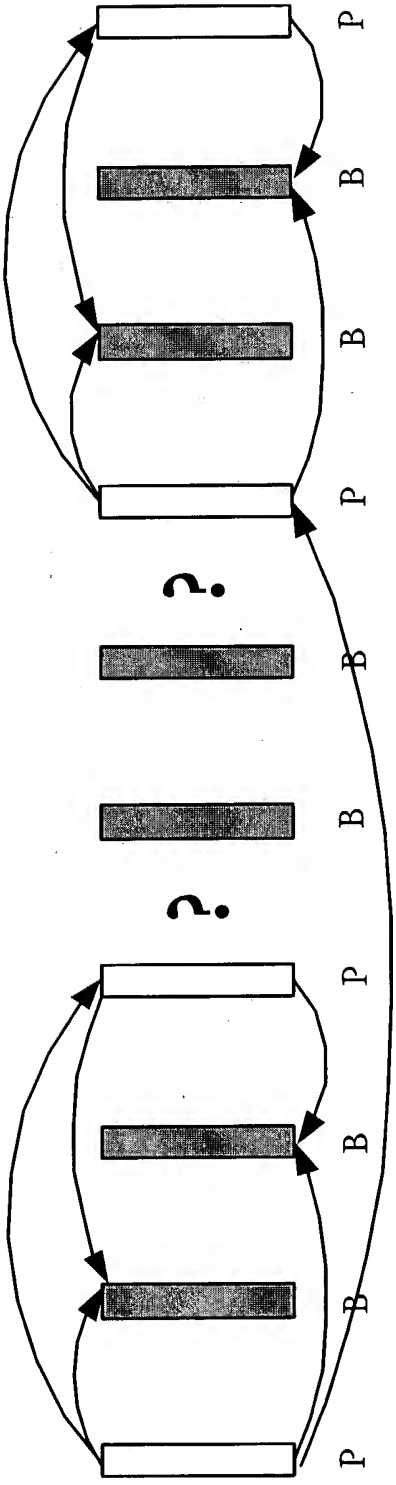


Fig. 5

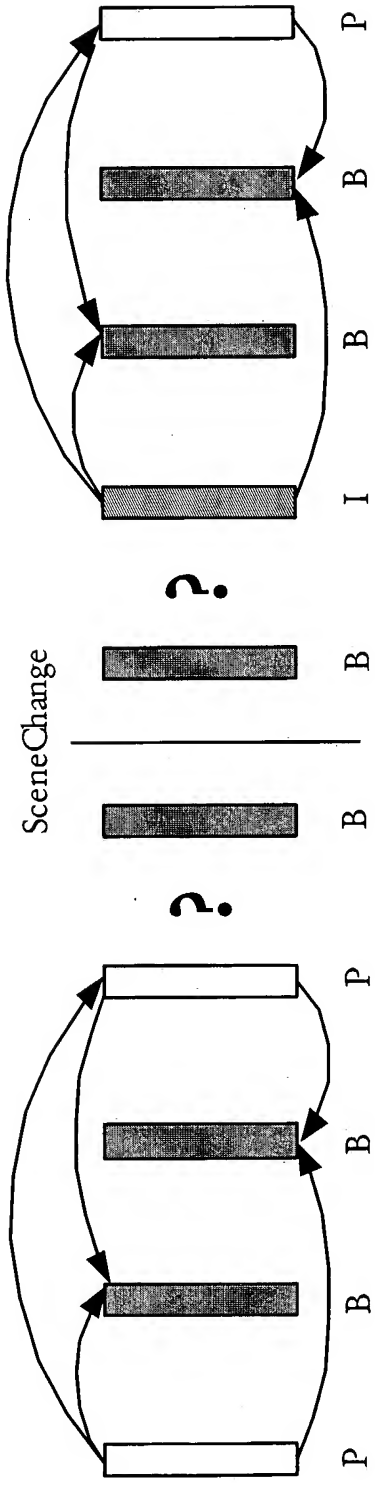


Fig. 6

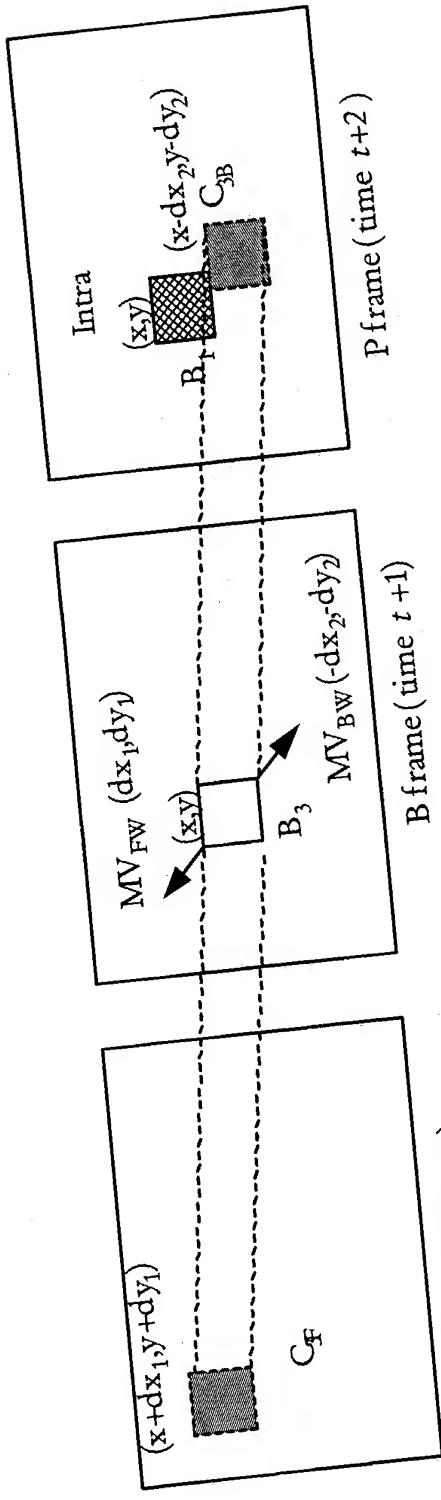

Intra
(x,y)
(x-dx2,y-dy2)
C3B
B1
P frame (time t+2)
MVFW (dx1,dy1)
(x,y)
B3
MVBW (-dx2,-dy2)
B frame (time t+1)
(x+dx1,y+dy1)
CF
P frame (time t)

Fig. 7

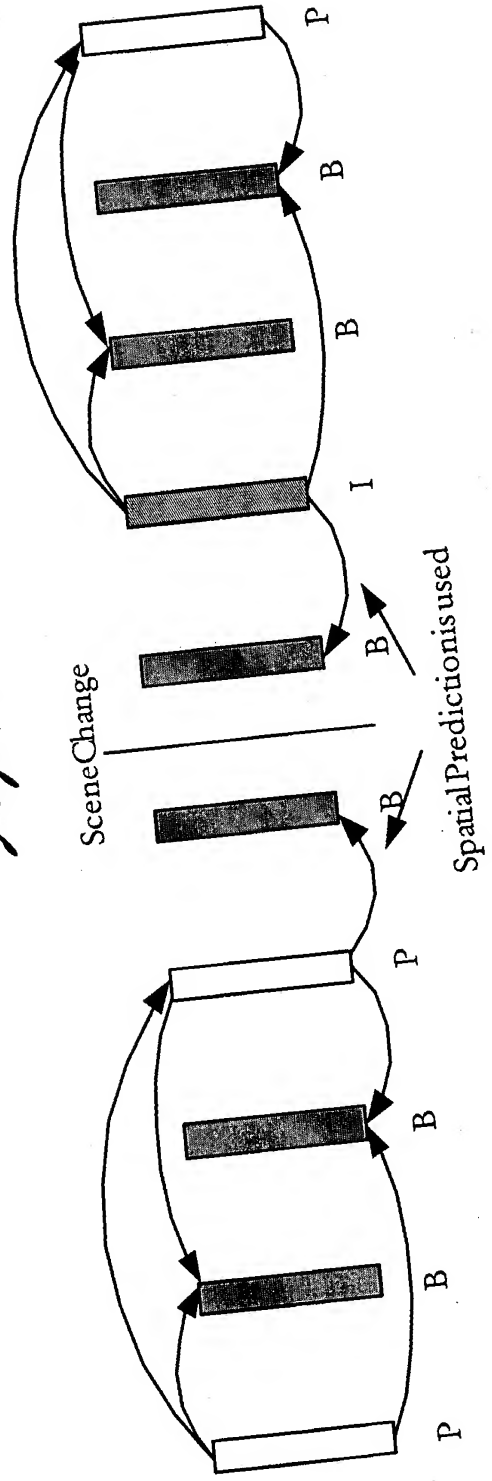

P
B
B
I
B
B
P
B
B
P
Scene Change
Spatial Prediction is used

Fig. 8

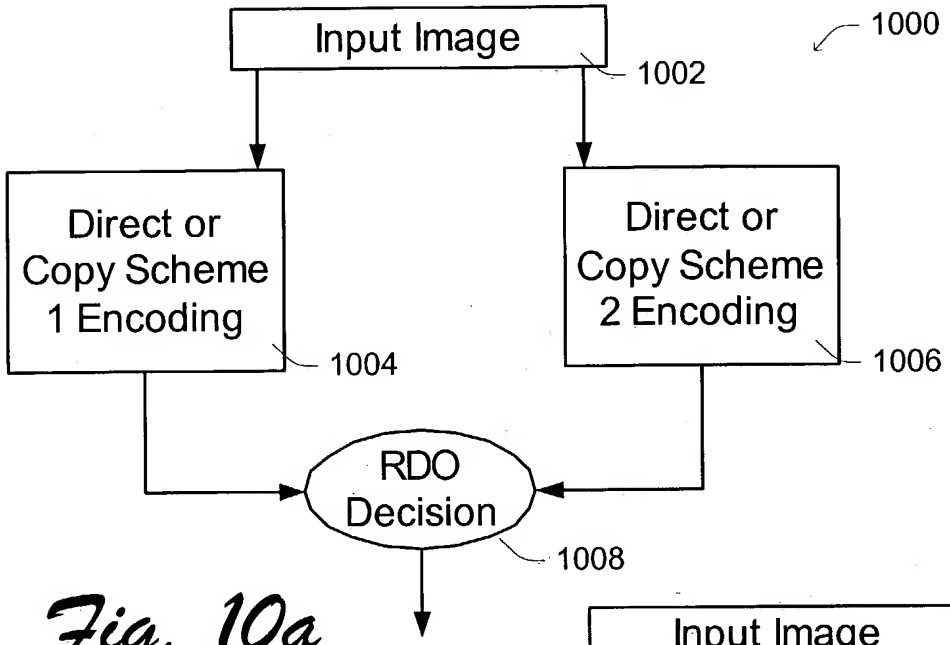


Fig. 10a

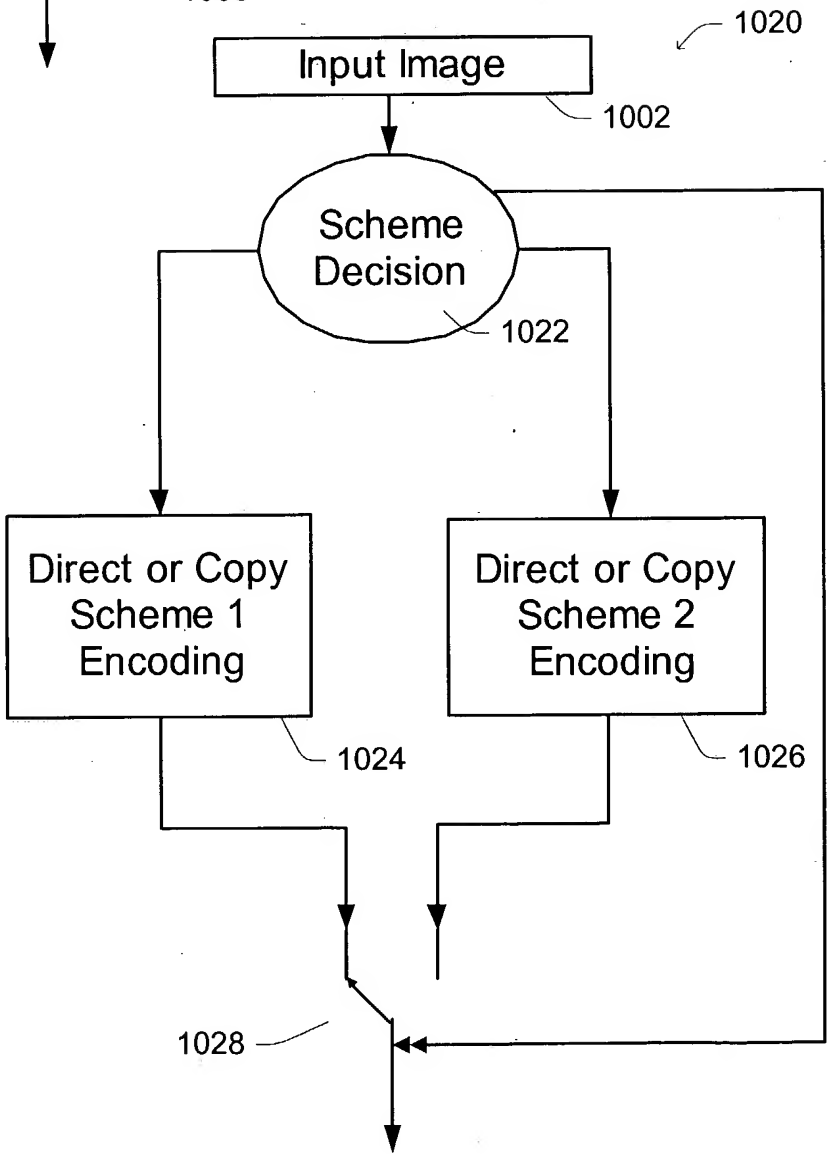


Fig. 10b

slice_header( ) {	Category	Descriptor
parameter_set_id	4	e(v)
first_mb_in_slice	4	e(v)
if (coding_type( ) = = Inter || coding_type( ) = = Bipred) {		
num_ref_pic_active_fwd_minus1	4	e(v)
if(coding_type( ) = = Bipred)		
num_ref_pic_active_bwd_minus1	4	e(v)
if(coding_type( ) = = Inter)		
copy_mv_spatial	4	u(1) or e(v)
if(coding_type( ) = = Bipred) {		
direct_mv_spatial	4	u(1) or e(v)
if(direct_mv_spatial) {		
direct_mv_scale_fwd	4	e(v)
direct_mv_scale_bwd	4	e(v)
direct_mv_scale_divisor	4	e(v)
}		
explicit_B_prediction_block_weight_indication		e(v)
if (explicit_B_prediction_block_weight_indication > 1)		
adaptive_B_prediction_coeff_table( )		
}		
}		
rps_layer( )		
slice_qp_minus26 /* relative to 26 */	4	e(v)
if(coding_type( ) = = SP || coding_type( ) = = SI) {		
if (coding_type( ) == SP)		
sp_for_switch_flag	4	u(1)
slice_qp_s_minus26 /* relative to 26 */	4	e(v)
}		
if(entropy_coding_mode = = 1)		
num_mbs_in_slice	4	e(v)
}		

Fig. 11

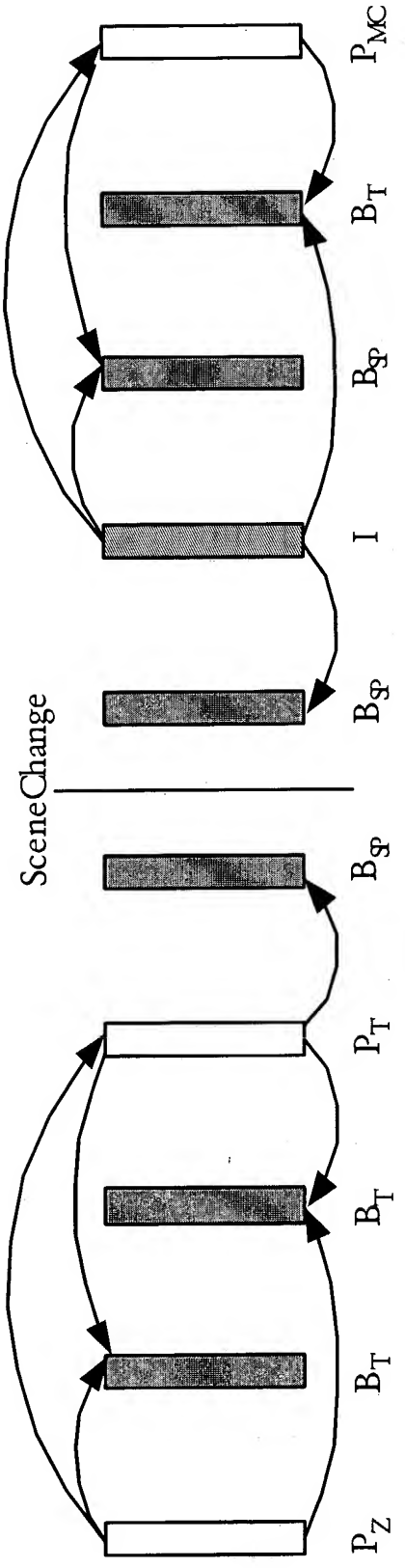

P_Z
B_T
B_T
P_T
B_SP
SceneChange
B_SP
I
B_SP
B_T
P_MC

Fig. 12

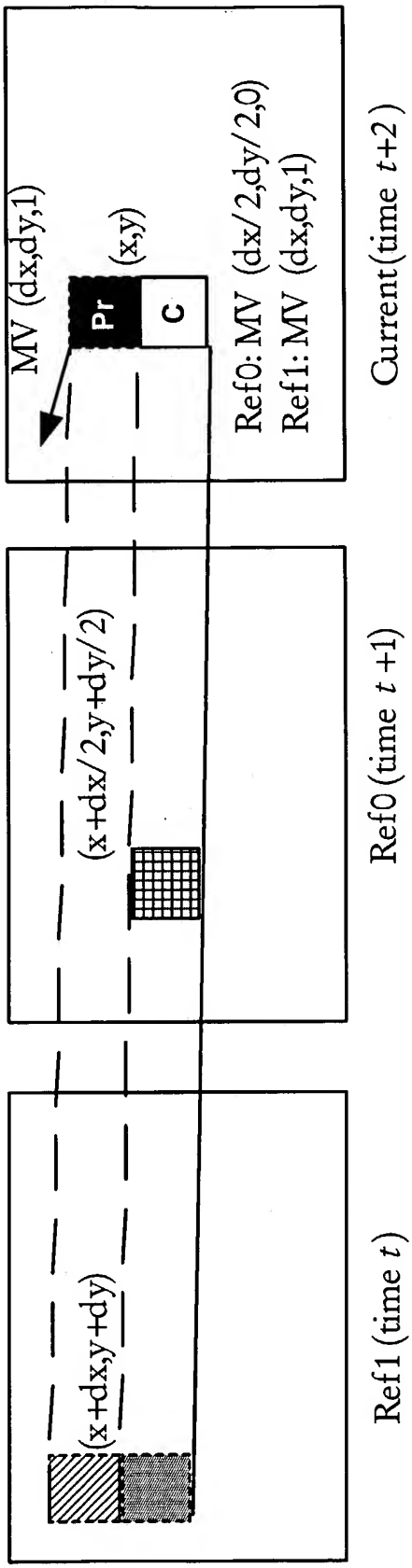

Ref1 (time t)
(x+dx,y+dy)
Ref0 (time t +1)
(x+dx/2,y+dy/2)
Current (time t+2)
MV (dx,dy,1)
Pr
(x,y)
C
Ref0: MV (dx/2,dy/2,0)
Ref1: MV (dx,dy,1)

Fig. 18

Modes for 8x8 blocks in B pictures/slices

Code number	8x8 partition mode	num_subblock_block8x8( )	block_prediction_mode( )
0	Direct8x8	1	Direct
1	8x8	1	Fwd
2	8x8	1	Bwd
3	8x8	1	Bipred
4	8x4	2	Fwd
5	4x8	2	Fwd
6	8x4	2	Bwd
7	4x8	2	Bwd
Removed	8x4	2	Bipred
Removed	4x8	2	Bipred
8	4x4	4	Fwd
9	4x4	4	Bwd
Removed	4x4	4	Bipred
10	Intra8x8	1	Intra

Fig. 13

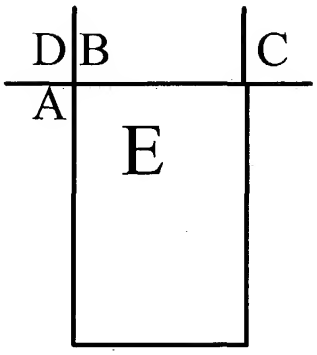
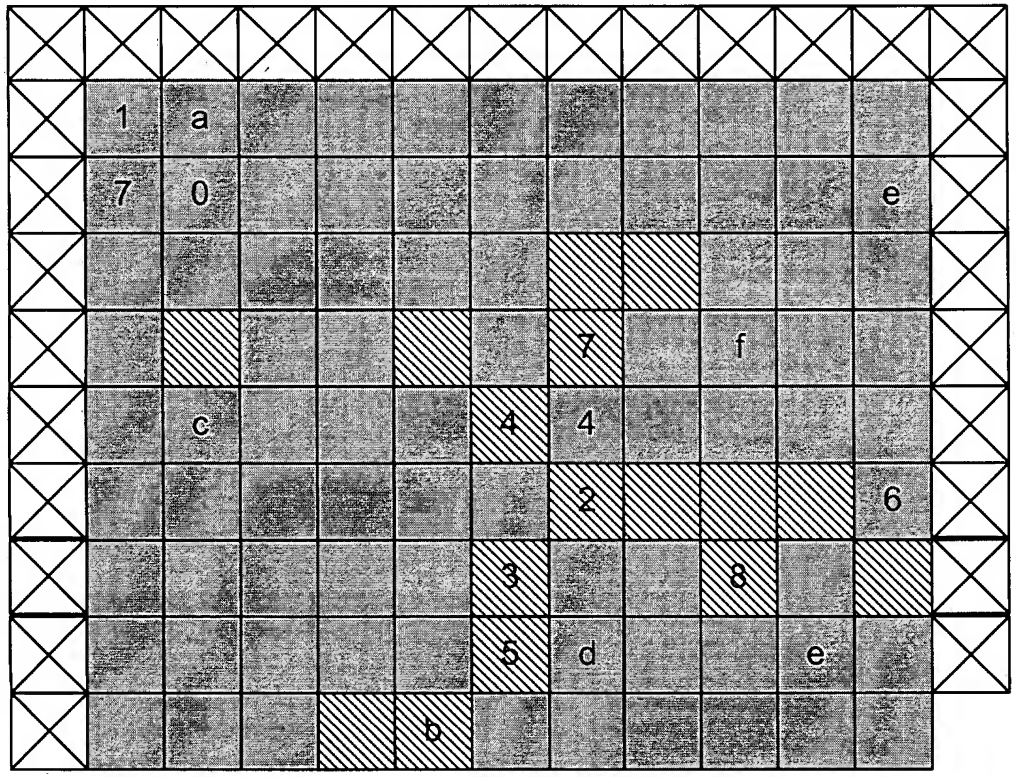


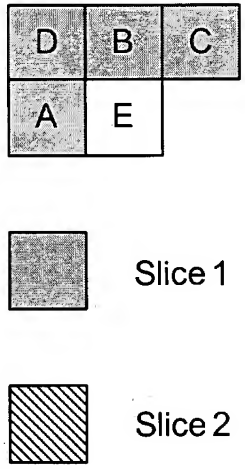
Fig. 14

P-Picture Motion Vector Prediction (Non-Skip, non-8x16, non-16x8 MBs)

Availability of Neighbor MV				MV Prediction v_E derivation for E	Defined
A	B	C	D		
0	0	0	0	**1st rule:** $v_A=0$; $v_D=0$; $r_A \neq r_E$; $r_D \neq r_E$; **2nd rule:** $v_E=v_A=0$;	√
0	0	0	1	**3rd rule:** $v_C=v_D$; $r_C=r_D$; v_E Not defined since v_A not defined.	×
0	0	1	0	**1st rule:** $v_A=0$; $v_D=0$; $r_A \neq r_E$; $r_D \neq r_E$; v_E Not defined since v_B not defined.	×
0	0	1	1	v_E Not defined since v_A and v_B not defined.	×
0	1	0	0	**1st rule:** $v_A=0$; $v_D=0$; $r_A \neq r_E$; $r_D \neq r_E$; **3rd rule:** $v_C=v_D=0$; $r_C=r_D \neq r_E$; **4th rule: if B uses same reference picture as E, then** $v_E=v_B$; **else** v_E=median(v_A, v_B, v_C)=median(0, v_B, 0)=0;	√
0	1	0	1	**3rd rule:** $v_C=v_D$; $r_C=r_D$ v_E Not defined since v_A not defined.	√
0	1	1	0	**1st rule:** v_A=0; v_D=0; $r_A \neq r_E$; $r_D \neq r_E$; **4th rule: if one and only one of B, C uses same reference picture as E, then** $v_E=v_B$ or v_C (whichever uses same ref pic); **else** v_E=median(v_A, v_B, v_C)=median(0, v_B, v_C); [even if v_B and v_C use different reference pictures than v_E]	√
0	1	1	1	v_E Not defined since v_A not defined.	×
1	0	0	0	**2nd rule:** $v_E=v_A$;	√
1	0	0	1	**3rd rule:** $v_C=v_D$; $r_C=r_D$ v_E Not defined since v_B not defined.	×
1	0	1	0	v_E Not defined since v_B not defined.	×
1	0	1	1	v_E Not defined since v_B not defined.	×
1	1	0	0	**3rd rule:** $v_C=v_D$; $r_C=r_D$ v_E Not defined since v_D not defined.	×
1	1	0	1	**3rd rule:** $v_C=v_D$; $r_C=r_D$ **4th rule: if one and only one of A, B, C(D) uses same reference picture as E, then** $v_E=v_A$ or v_B or v_C (whichever uses same ref pic); **else** v_E=median(v_A, v_B, v_C); [even if one or two of v_A, v_B and v_C use different reference pictures than v_E]	√
1	1	1	0	**4th rule: if one and only one of A, B, C uses same reference picture as E, then** $v_E=v_A$ or v_B or v_C (whichever uses same ref pic); **else** v_E=median(v_A, v_B, v_C) [even if one or two of v_A, v_B and v_C use different reference pictures than v_E]	√
1	1	1	1	**4th rule: if one and only one of A, B, C uses same reference picture as E then** $v_E=v_A$ or v_B or v_C (whichever uses same ref pic); **else** v_E=median(v_A, v_B, v_C); [even if one or two of v_A, v_B and v_C use different reference pictures than v_E]	√

Fig. 15





R_X:reference frame
M_X: motion vector
NotAvailable:
$R_X = -1, M_X = 0$

Not Available Blocks				
A	B	C	D	case
0	0	0	0	1
0	0	0	1	2
0	0	1	0	3
0	0	1	1	4
0	1	0	0	5
0	1	0	1	6
0	1	1	0	7
0	1	1	1	8
1	0	0	0	9
1	0	0	1	a
1	0	1	0	b
1	0	1	1	c
1	1	0	0	d
1	1	0	1	e
1	1	1	0	f
1	1	1	1	0

MS1-1252US

JVTRules:

R0: Median rule is applied for Motion vector calculation: M_E=Median(M_A,M_B,M_C)
R1: A, D outside of picture => $R_A = R_D = -1, M_A = M_D = 0$
R2: B, C, D outside of picture => $M_E = M_A$
R3: C not available (outside of picture, not yet coded etc) C is replaced by D
R4: if X is intra, then R_X=-1 (no definition on M_X - code sets $R_X = -1, M_X = 0$)
R5: if X (X∈ {A, B, C}) and only X has $R_X == R_E$ then $M_E = M_X$

Fig. 16

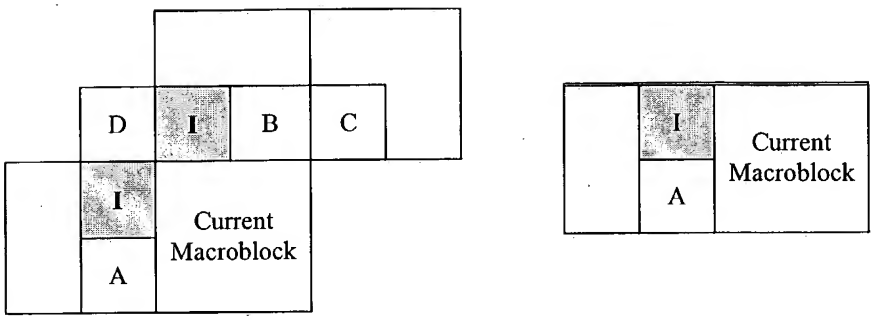

D
I
B
C
I
Current Macroblock
A
I
A
Current Macroblock
(a)
(c)

Fig. 17

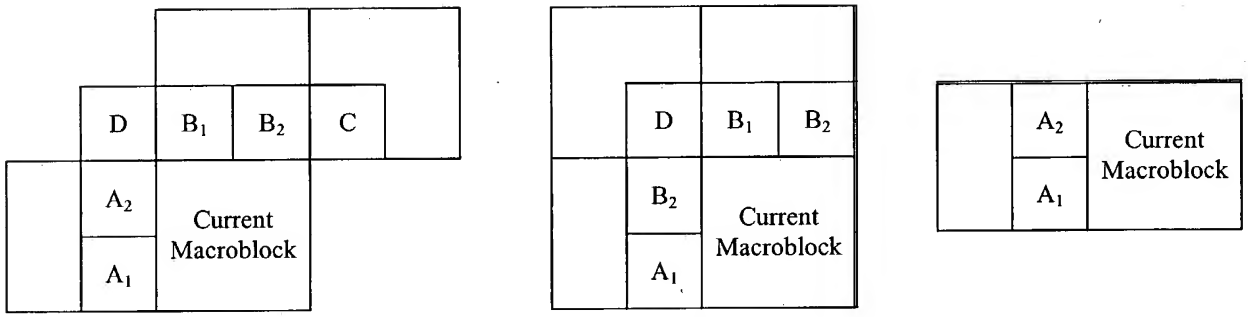

D
B1
B2
C
A2
A1
Current Macroblock
(a)
D
B1
B2
B2
A1
Current Macroblock
(b)
A2
A1
Current Macroblock
(c)

Fig. 19

Relationship between previous λ and current one.

QP	$\lambda_{I,P}^{Prev} = 5 \times \frac{QP+5}{34-QP} \times \exp^{\frac{QP}{10}}$	$\lambda_{I,P}^{Curr} = 0.85 \times 2^{\frac{QP}{3}}$	$\frac{\lambda_{I,P}^{Curr} - \lambda_{I,P}^{Prev}}{\lambda_{I,P}^{Curr}}$
16	28.89	34.27	18.61%
17	35.42	43.18	21.90%
18	43.48	54.40	25.11%
19	53.49	68.54	28.14%
20	65.97	86.35	30.89%
21	81.66	108.80	33.23%
22	101.53	137.08	35.01%
23	126.94	172.71	36.05%
24	159.84	217.60	36.14%
25	203.04	274.16	35.03%
26	260.86	345.42	32.42%
27	340.11	435.20	27.96%
28	452.23	548.32	21.25%

Fig. 20

Performance different of Proposed Schemes/Draft text and proposed RDO vs current software (JM3.3)

Scheme	ref	Entropy	Sequence	Foreman	Container	News	Paris	Silence	Mobile	Tempete
MVP	1	UVLC	PSNR gain	0.190	0.076	-0.027	0.270	0.099	0.220	-0.135
			Bitrate diff	3.43%	1.39%	-0.47%	5.04%	2.06%	4.43%	-3.53%
	5	UVLC	PSNR gain	0.221	0.037	0.004	0.318	0.129	0.256	-0.156
			Bitrate diff	3.98%	0.59%	0.07%	5.96%	2.66%	4.81%	-4.00%
MVP	1	CABAC	PSNR gain	0.081	0.022	-0.026	0.194	0.062	0.116	-0.167
			Bitrate diff	1.52%	0.40%	-0.45%	3.65%	1.25%	2.32%	-4.32%
	5	CABAC	PSNR gain	0.101	0.011	0.009	0.233	0.100	0.150	-0.183
			Bitrate diff	1.89%	0.21%	0.14%	4.37%	2.04%	2.93%	-4.70%
T+MVP	1	UVLC	PSNR gain	0.020	-0.006	0.010	0.001	0.004	0.001	0.004
			Bitrate diff	0.37%	-0.13%	0.18%	0.03%	0.09%	0.02%	0.11%
	5	UVLC	PSNR gain	0.063	-0.009	0.025	0.016	0.033	0.015	-0.028
			Bitrate diff	1.14%	-0.18%	0.43%	0.30%	0.70%	0.31%	-0.70%
T+MVP	1	CABAC	PSNR gain	0.011	-0.004	0.006	0.003	-0.001	0.002	0.006
			Bitrate diff	0.20%	-0.08%	0.09%	0.06%	-0.01%	0.05%	0.16%
	5	CABAC	PSNR gain	0.025	-0.015	0.018	0.014	0.023	0.016	-0.024
			Bitrate diff	0.47%	-0.27%	0.31%	0.27%	0.48%	0.34%	-0.62%
T+MVP RDO	1	UVLC	PSNR gain	0.069	0.439	0.106	0.370	0.144	0.629	0.226
			Bitrate diff	1.26%	8.27%	1.87%	6.81%	2.96%	12.15%	5.48%
	5	UVLC	PSNR gain	0.111	0.406	0.119	0.393	0.163	0.676	0.196
			Bitrate diff	2.00%	7.53%	2.07%	7.29%	3.33%	12.19%	4.66%
T+MVP RDO	1	CABAC	PSNR gain	0.040	0.390	0.107	0.288	0.113	0.529	0.196
			Bitrate diff	0.73%	7.26%	1.80%	5.36%	2.29%	10.32%	4.79%
	5	CABAC	PSNR gain	0.056	0.375	0.120	0.304	0.127	0.550	0.159
			Bitrate diff	1.05%	6.91%	1.97%	5.64%	2.59%	10.40%	3.82%
Draft	5	UVLC	PSNR gain	-0.012	-0.047	-0.018	-0.003	0.000	-0.080	-0.120
			Bitrate diff	-0.22%	-0.90%	-0.32%	0.07%	0.00%	-1.72%	-3.03%
	5	CABAC	PSNR gain	-0.003	-0.042	-0.016	0.000	0.004	-0.067	-0.112
			Bitrate diff	-0.05%	-0.78%	-0.26%	-0.01%	0.08%	-1.43%	-2.85%

Fig. 21

Comparison of encoding performance for different values of λ.

A	QP_B	Sequence	Foreman	Container	News	Paris	Silence	Mobile	Tempete
500	QP_P	PSNR	0.128	-0.015	0.084	0.117	0.039	0.280	0.156
		Bitrate	3.43%	-0.33%	2.01%	2.85%	1.06%	6.35%	3.89%
	QP_P+1	PSNR	0.102	-0.111	0.057	0.048	0.005	0.133	0.094
		Bitrate	2.58%	-2.78%	1.39%	1.19%	0.16%	3.04%	2.35%
700	QP_P	PSNR	0.070	0.034	0.061	0.079	0.009	0.176	0.086
		Bitrate	1.87%	0.79%	1.43%	1.97%	0.19%	4.08%	2.19%
	QP_P+1	PSNR	0.060	-0.012	0.043	0.046	0.002	0.090	0.057
		Bitrate	1.60%	-0.35%	0.97%	1.16%	0.03%	2.19%	1.52%

Fig. 22

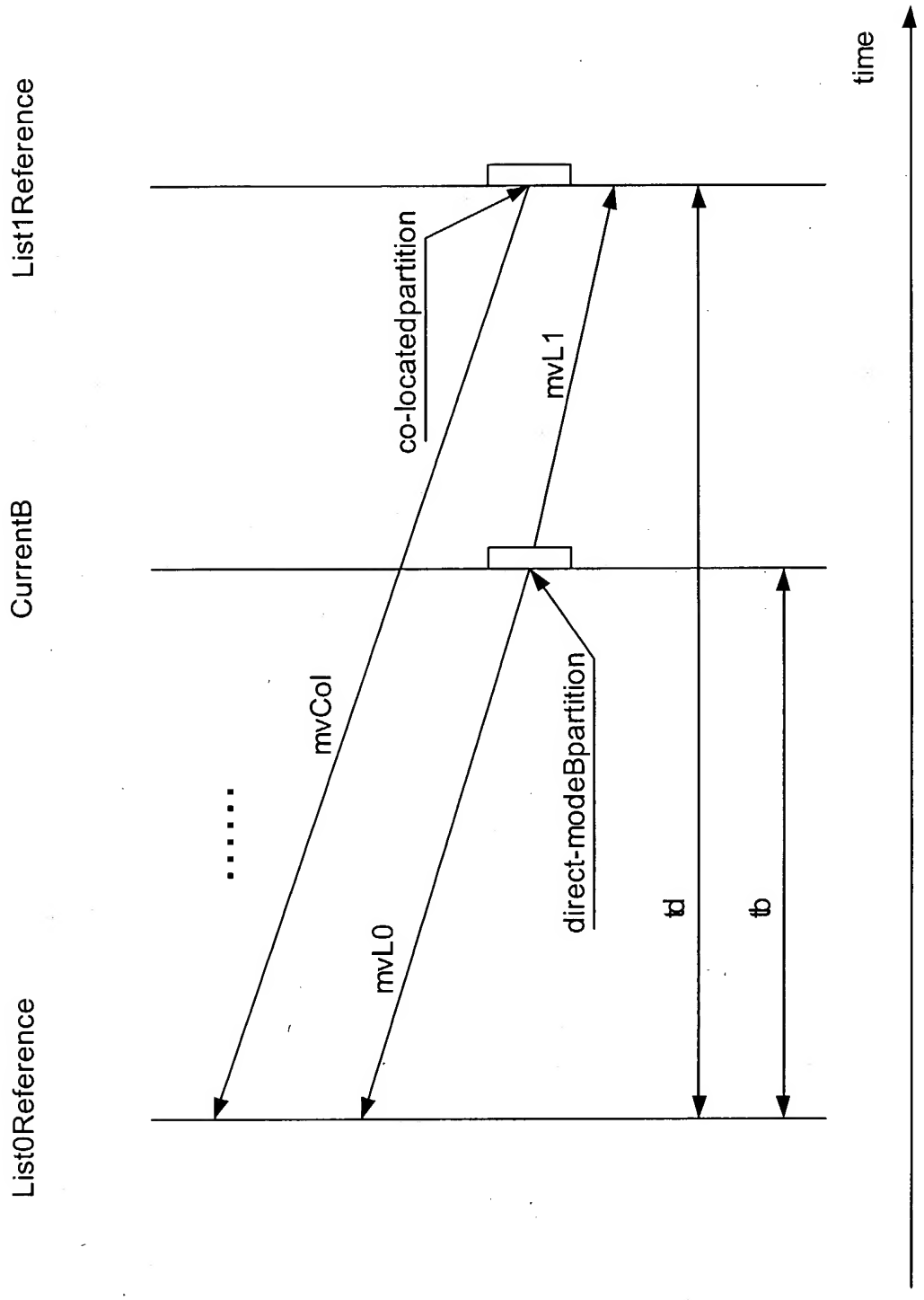

List1Reference
CurrentB
List0Reference
time
co-locatedpartition
mvL1
mvCol
mvL0
direct-modeBpartition
td
tb

Fig. 23